NUCLEAR AND RADIOLOGICAL TERRORISM THREATS FOR INDIA: RISK POTENTIAL AND COUNTERMEASURES

Rajesh M. Basrur

Director, Centre for Global Studies,
5/157 "Bhagyalaxmi"
Sir Bhalchandra Road, Dadar,
Mumbai 400 014
India

Tel: 91-22-2414-3500
e-mail: rmbasrur@hotmail.com

and

Friedrich Steinhäusler

Professor, Institute of Physics and Biophysics
University of Salzburg
Hellbrunnerstr. 34
A-5020 Salzburg
Austria

Tel: +43-662-8044-5701
e-mail: friedrich.steinhaeusler@sbg.ac.at

NUCLEAR AND RADIOLOGICAL TERRORISM THREATS FOR INDIA: RISK POTENTIAL AND COUNTERMEASURES

1. Introduction

In an era characterized by the rising threat of indiscriminate terrorism and the diffusion of instruments of mass destruction, the possibility of nuclear/radiological terrorism, though yet unrealized to a significant degree, is a grave one (Leventhal & Alexander, 1986; Cameron, 1999). India is particularly vulnerable to such threats owing to the wide distribution of nuclear/radiological material and concurrent threats from numerous terrorist groups. Few studies have attempted to gauge the extent of the problem (Leventhal & Chellaney, 1988; Basrur & Rizvi, 2003). In this paper, we attempt to identify possible threat scenarios arising from nuclear/radiological terrorism, the sources of threat, and countermeasures to combat the threat.

2. Terrorist threat scenarios in India

2.1 Radiological terrorism

One of the possible malevolent acts involving radioactive material is its dispersion during an act of terrorism, using a *Radiological Dispersal Device (RDD)*. Such a radiological weapon can be deployed in several manners (e.g., dispersion of radioactive aerosol; detonating radioactive material with conventional explosives ("dirty bomb")).

In addition, diverted strong radioactive sources can also be used to maim or kill a victim by covertly exposing the individual to ionizing radiation for extended periods of time.

Once terrorists have obtained radioactive material, they still have to fulfill several logistical requirements before they actually carry out an act of radiological terrorism, such as: knowledge about the targeted facility; provision of adequate manpower and vehicels to transport the source; access to tools for dismantling the source.

These kinds of attacks would result in a wide range of radiation doses to the victims and First Responders (police, paramedics, and firefighters), though in most cases unlikely to be life-threatening. However, it is questionable whether initially Indian authorities would even be aware of the fact that a terror act involving radioactive materials has occurred, since most first responders are neither trained, nor technically equipped to detect the presence of radiation at the site of a terror attack. It is safe to presume that terrorists in India would have to inform the media first about the deployment of radioactive material in order to achieve the desired level of panic among the general public.

In summary, the impact of a radiological terrorist attack on Indian society will be largely due to mass panic rather than radiation-induced health effects, since the individual radiation doses are likely to be too small to cause acute or somatic radiation syndromes.

However, there will be significant environmental clean-up costs and indirect economic damages, such as devaluation of urban property value and loss of agricultural market share due to stigmatization of the contaminated target area, even after successful clean-up operations.

2.2 Terrorist attacks on the nuclear infrastructure in India

India's nuclear establishment, most of it civilian, is large (Gopalakrishnan, 2002). Despite a high level of security and inherent safety features, there are several security risks for Indian nuclear power plants (NPPs) from terrorists, such as:

- A small team of trained saboteurs gains access to an NPP, possibly with an insider's assistance, and detonates explosives at sensitive points to cause a release of radioactivity; or
- A convoy of suicide truck bombers crashes through the weakest point of entry of an NPP (usually the entry gate for transport), with the surviving truck(s) attacking vital installations of the NPP; or
- A suicide commando hijacks a fully fuelled large civilian aircraft and crashes it into the spent fuel storage pool of the NPP.

The attack mode entailing truck bombs is generally accepted, acknowledging that even a large conventional bomb detonated *outside* the fence barriers surrounding an NPP might cause "unacceptable damage to vital reactor systems", potentially resulting in an uncontrolled, major release of radioactivity (Sandia National Laboratories, 1984).

The degree of vulnerability of an NPP to air attacks is subject of intense investigation worldwide at present. Preliminary results range from affirming that aircraft crashes may result in multiple-failure initiating events ("Massachusetts Congressman Says Nuclear Plants Are Vulnerable," 2002), to negating that a commercial, fully fuelled large airliner could penetrate an NPP and release radioactivity (Nuclear Energy Institute, 2002), or cause a major disaster ("The Canadian Nuclear FAQ – Section D," n.d.b). However, it is not known what effect an aircraft loaded with high explosives might have if it crashes into a typical Indian reactor building. The two VVER-1000 type plants being built by Russia at Koodankulam in the southern Indian state of Tamil Nadu may be inherently vulnerable to an airliner crash. Weaknesses of existing plants of this type include the inadequate strength of walls and roof, the location of the control room at the lower levels of the reactor building (necessitating early evacuation in case of melt-through of the containment), and close proximity of steam lines and isolation valves, creating vulnerability to a single blast (Hirsch, H, 2001).

Besides an attack on the reactor building of an NPP, it is necessary to consider also the consequences of an aerial terrorist attack on the spent fuel storage pool. In India, these facilities typically have strong concrete walls with steel liners to protect against leaks. However, usually the roof structure is not hardened and thereby vulnerable to an aircraft crashing into the storage area. Such pools hold on average up to ten times more long-lived radioactivity than a reactor core. Provided the aircaft crash results in a loss of coolant from the pool and cannot be replced in time, this would expose the fuel elements

to the ambient environment, i.e. a mixture of burning jet fuel, air and steam. If the cooling water - acting as a radiation shield - dropped to about 1 meter above the spent fuel rods, this would result in an excessively high radiation dose for an intervention team, inhibiting them to replenish the coolant in time. Once the fuel rods are exposed to steam and air, the zirconium cladding of the fuel elements would react exothermically with temperatures of about 1,000 degrees C, resulting in a fire and releasing large amounts of radioactivity into the environment.

2.3 Nuclear Weapons, Terrorism, and Inter-State Conflict

One aspect that has received inadequate attention is the relationship between terrorism and the regional politics of nuclear weapons. The region is characterized by the active presence of terrorists who have the potential for indiscriminate mass violence, and by the growth of nuclear tensions, particularly after both countries tested in1998. The long-standing hostility between India and Pakistan has the potential to facilitate nuclear/radiological terrorism in a number of ways.

At the time of writing, both countries are believed to keep their warheads unmated (with delivery vehicles) and unassembled (Cirincione, Wolfstahl & Rajkumar, 2002: 191, 207). However, this may change over time if tensions persist. There may be a shift to crisis deployment or to peacetime deployment The scope for terrorists to determine the course of events in the region parallels the nuclear stances of India and Pakistan. Each form of nuclear posture carries some risk of terrorist involvement.

- *Unassembled weapons* keep the direct risk of war relatively low. However, there is still an element of risk vis-à-vis terrorism. At worst, a nuclear core or subassembly could be stolen or taken by force and used for (a) the making of a nuclear weapon; or (b) the manufacture of an RDD. Alternatively, a nuclear core could be targeted with conventional explosives (CE) and detonated as an RDD.
- *Assembled but undeployed weapons* could be stolen or taken by force. Even if they are not directly usable, the threat to use them would still be "credible." After all, nuclear weapons possessed by states are said to be "non-usable," but still have powerful strategic effects. Terrorists might also choose to use a nuclear bomb thus obtained in conjunction with CE to produce an RDD. Assembled weapons, whether mated with delivery vehicles or not, could be targeted and detonated with CE at the storage site.
- *Weapons components or assembled weapons under transportation during the process of deployment* would be particularly vulnerable in all the respects identified above. Stationary targets are easier to hold secure, moving ones far more difficult to protect. In particular, road and rail transport offer a wide range of choices to attackers.
- *Deployed weapons* would be relatively safer, but only relatively. Weapons deployed at stationary sites such as air bases and silos would still be vulnerable to terrorist attack. Mobile deployment, likely to be activated during a crisis, would increase the level of risk.

- *Attacks using bombs/materials obtained elsewhere* cannot be ruled out. Pakistan and the former Soviet Union are potential sources for such material. Nuclear/radiological attacks on military forces in general, and nuclear forces in particular, could have devastating effects and carry the potential to unleash nuclear war.

The effects of the modes of attack identified above could be very serious. In all cases, the likelihood of a crisis occurring is high. The terrorist attack on India's Parliament brought the two countries close to war. A nuclear/radiological attack could spark off an armed clash. This might happen as a result of an escalating crisis and high-tension nuclear confrontation. Alternately, a nuclear/radiological terrorist attack, particularly at a time of crisis, could be misperceived as an enemy assault. The "response" would likely be quick, and the consequence horrendous.

3. Sources of Threat

3.1. Illegal Acquisition of Nuclear and Other Radioactive Material from India and Abroad

There are multiple possibilities for terrorists to obtain radioactive material in India suitable for an RDD, such as: hospitals (in particular cancer treatment centers); research facilities (e.g., at universities); oil- and gas exploration industry; road construction industry; and steel manufacture. Radioactive materials used for industrial and medical applications are estimated at over 10,000 units, and include 230 telegammatherapy units containing Co 60; 140 brachytherapy units containing Co 60, Ir 192, Cs 137, and Sr 90; 1,100 industrial gamma exposure devices with Ir 192 and Co 60; 7,500 nucleonic gauges containing Am 241, Am-Be 241, Cs 137, and Co 60; and 50 medical and industrial linear accelerators or LINACS with depleted uranium as shielding material (Kumar et al, 2002).

Typically, physical protection at these sites is rather lax, at best comparable to the protection provided at a jeweler shop, i.e., not a real logistical problem for a trained team of adversaries. Even in a highly industrialized country like the US, aiming for a "cradle-to-grave" supervision of radioactive material, on average every year control is lost over about 200 such sources (Dicus, 1999). It is safe to assume that the situation is at best equal in India.

In India, numerous cases of theft have occurred in recent years. For instance, in July 1998, the Central Bureau of Investigation seized over eight kilograms of natural uranium stolen from the Indira Gandhi Centre for Atomic Research (IGCAR) in Chennai ("Uranium Racket Unearthed," 2002). Besides, it is difficult to ensure security over materials that are outside the direct control of the state, such as radiological sources in the possession of hospitals and industries. In July 2002, a gamma radiography camera containing Ir 192 with an activity of 729 GBq was stolen during transportation in the northeastern state of Assam. A disturbing aspect of the incident was that the camera, a highly radioactive device, was left unlocked in the trunk of a public bus in a region plagued by terrorist activity ("Radiation Scare in Assam," 2002). Although Atomic

Energy Commission (AEC) Chairman Anil Kakodkar claimed there was no need to panic, the fact remains that the camera was a powerful potential source for a dirty bomb ("No Chance of N-Material Falling into Wrong Hands, " 2002). Again, in August 2003, a large quantity of Co 60 was stolen from a steel plant in Jamshedpur in . Though the material was guarded by a sophisticated alarm system on the front door, the thieves simply bypassed it by breaking through the rear wall (Murty & Layak, 2003).

Terrorists might obtain nuclear materials and other radioactive material from outside India. A high probability for terrorists to get access to such materials exists in Russia, which has experienced in recent years a combination of terrorist violence, the growth of organized crime, and an abundance of poorly guarded nuclear facilities (Schweitzer & Schweitzer, 2002: 51-81). William Potter has identified seven cases of diversion of significant quantities of nuclear material, and four other possible cases (Potter, 1997). More alarming, a February 2002 assessment by the US National Intelligence Council states that undetected diversion of weapons-grade and weapons-usable materials has taken place from Russian institutes, but "we do not know the extent or magnitude of such thefts" (Wolfsthal & Collina, 2002: 71). Russia is estimated to possess 150 tons of weapons-grade plutonium, 1,000 tons of enriched uranium, and, at the Chelyabinsk complex alone, 685,000 cubic meters of radioactive waste (Cameron, 1999: 2). Given the reality of poor accounting, organizational deterioration owing to adverse economic conditions, and inadequate physical protection of nuclear and other radioactive material, it is not surprising that there are numerous examples of material diversion: 67 thefts and seizures involving nuclear material, and 97 such cases involving other radioactive material have become known in Russia since 1991 (Database on Nuclear Smuggling, 2003). Insiders commit most thefts of nuclear material. Moreover, projections of Russian weapons inventories show that, over the next decade, about 3,500 warheads containing about 84,000 kilograms of fissile material will be removed from deployment (Wolfsthal & Collina, 2002: 73). Despite assistance from the US and from other countries, the potential for leakage remains considerable.

Pakistan too is a significant potential source for acquiring nuclear and other radioactive material (Basrur & Rizvi, 2003: 47-62). Though its overall nuclear infrastructure is relatively small, the possibility of leakage is widely feared because of the general sense of the country as a failing state. Pakistan's main uranium enrichment facility is at Kahuta (Khan Research Laboratories). Smaller uranium enrichment facilities exist at Sihala and Golra, and possibly at Gadwal. Plutonium extraction work is done at the New Lab, Nilhore, and at Khushab in central Punjab. Pakistan has two nuclear power plants. One is located at Karachi, the other at Chasma. Its nuclear weapons are believed to be in an unassembled state, with the fissile core kept separate from the bomb assembly. The bomb components and the wider infrastructure are under military control. In February 2000, a National Command Authority was established. In January 2001, the Pakistan Nuclear Regulatory Authority (PNRA) was created to regulate the civilian infrastructure. Still, given Pakistan's deteriorating law and order environment, the possibility of leakage remains. Bangladesh has also experienced the flow of contraband radioactive material. In July 2003, police seized a package of 225 grams of uranium oxide manufactured in

Kazakhstan from a suspected Islamic militant group, the Jamaat-ul-Mujahideen (Gargi, 2003).

3.2. India's Nuclear Power Infrastructure

India's Atomic Energy Commission (AEC) stands at the apex of an extensive infrastructure that incorporates warhead manufacture, electrical power production (14 reactors, with 6 more under construction), uranium mining, fuel fabrication and reprocessing, waste management, research, and medical and industrial applications. An independent body, the Central Industrial Security Force (CISF), a paramilitary force under the Ministry of Home Affairs, manages the physical security of nuclear installations. The CISF is also responsible for the protection of other high-risk facilities, such as defense production units, space installations, oil refineries and major ports. But little is known about how it actually organizes the security of nuclear facilities. Personal conversations with retired officials indicate that security is tight, enhanced by the fact that the CISF does not fall under the purview of the Department of Atomic Energy. The Bhabha Atomic Energy Research Centre (BARC) has an on-going program for the development of sophisticated security systems, such as a voice-activated phonetic identification system. The Atomic Energy Regulatory Board (AERB) is empowered to regulate all civilian facilities, while the BARC, which controls warheads, has an internal review mechanism for military-related facilities. Though much of the AERB's function is related to preventing and responding to accidents, part of the counter-terrorism function of controlling nuclear plants and other facilities and responding to emergencies would be covered by the same systems. The BARC is designated as a nuclear-weapons laboratory, and warhead components are stored there in an unassembled state (Hawksley, 2003). According to informed sources, the nuclear warheads located at BARC facilities are under military security. A study by P. R. Chari notes that the Indian Army provides air defense cover, security is strict, and access control is maintained by physical barriers and electronic systems (Chari, 1998).

Indian nuclear power plants (NPP) in themselves are characterized by a high level of built-in safety, which indirectly makes them relatively less vulnerable to sabotage. Several of the accident-related safety features of the CANDU reactor design used in India are also relevant to terrorist acts ("The Canadian Nuclear FAQ – Section D" n.d.a). For instance, the subdivision of the core into two thermalhydraulic loops in most CANDU designs and hundreds of individual pressure tubes within each loop localizes a loss-of-coolant incident. The large-volume, low-pressure, low-temperature moderator surrounding the pressure tubes keeps the risk of a fuel meltdown low. The steam generators are positioned well above the core, which promotes natural thermosyphoning (heat movement) in case shut-down cooling is lost. In addition, CANDU plants are enclosed by heavy concrete walls, including a reactor vault of minimum four feet thickness surrounding the nuclear core itself.

3.3. Organizational Vulnerabilities

Organizational vulnerabilities are of two kinds, internal and external. A serious potential

threat to nuclear facilities, whether military or civilian, comes from insiders. The range of possible threats includes theft of materials; support to outsiders by disruption of alarm systems; sabotage of facilities or specific processes (such as cooling systems); and simple acts such as providing building layouts or access codes to terrorists (Hirsch, D, 1987). Most acts of sabotage have been attributed to disgruntled employees expressing their anger by, among other things, cutting electrical cables, setting fires, and destroying security cameras ("Nuclear Terrorism," n.d.). But that does not rule out political motivations. Most nuclear-related organizations are also vulnerable to cyber-security threats: information on any aspect of a nuclear facility from bomb design to security measures can be misappropriated by an insider (Project on Government Oversight, 2001). It is important to recognize that the insider threat applies to military facilities too. Herbert Abrams has illustrated the seriousness of the problem by recording the significant levels of psychiatric disorders and drug and alcohol abuse, as well as of actual violent acts, by military personnel cleared through personnel reliability screening programs (Abrams, 1991). While this study applies to the US armed forces, there is no reason to believe that military personnel elsewhere are significantly different in their behavior patterns. Available information on personnel reliability is scanty. The potential for serious damage is evident from a parallel case: the killing of Indira Gandhi by her own bodyguards.

Externally oriented security encompasses the intelligence network and asset protection. In one sense, there is ground for reassurance, since there are no known cases of significant security failure involving the nuclear infrastructure. But this may be the result of a lack of interest and effort thus far on the part of terrorists. A look at the general security environment and repeated organizational problems is instructive. Terrorists have periodically penetrated zones of high-level military security. Between November 1999 and July 2003, at least half a dozen attacks by terrorists on high-security army camps in the state of Jammu and Kashmir resulted in 92 deaths of soldiers and their families ("Complacency Making Army Vulnerable," 2003). In February 2003, five policemen guarding a vital bridge in Kashmir were divested of their rifles and ammunition by terrorists ("Probe Ordered into Disarming of Cops by Militants," 2003). Such incidents illustrate the relative ease with which areas under high levels of security cover are penetrated by small numbers of determined terrorists. A shocking security breach in a high-threat zone was the assault on India's Parliament by a small team of heavily armed terrorists in a car loaded with explosives in December 2001.

To take a related aspect, between April 2000 and May 2001, as many as six major fires occurred at Army ammunition dumps, some of them very large ones, such as the enormous fire that destroyed some 10,000 tons of ammunition in Bharatpur on April 28, 2000 ("Blowing Up in Our Faces, 2001; Thapar, 2001). In at least some cases, sabotage was involved. The fact that no nuclear facilities have so far been penetrated is not in itself reassuring in this respect. It is also notable that when India's nuclear tests were being carried out in 1998, an unauthorized individual – an Army washerman who had jumped into a military truck with other soldiers because he wanted to help – was discovered at the test site, that too by accident because he had been bitten by a scorpion (Chengappa, 2000: 422). All of this shows that however robust nuclear security may be, the possibility of failure, with its immense potential for disaster, must be accepted as real.

3.4. The Political Sources of Threat

Politics provides the key to gauging accurately the scale of risk, for ultimately, human motivation is the driving factor. What might motivate a terrorist to "go nuclear"? The history of terrorist mass destruction is a relatively sketchy and short one. The resort to nuclear terrorism, with its potential for mass annihilation, appears to have inherent constraints from the rational standpoint. Indeed, there are very few examples of mass killing by terrorists over the past hundred years or so (Falkenrath, Newman & Thayer, 1998: 47). Terrorists have numerous reasons for eschewing a strategy of mass casualty attacks (Falkenrath, Newman and Thayer, 1998: 45-59). They usually want to create fear, not revulsion. Resort to mass killing can alienate not only the public, but members of a terrorist organization as well. Terrorists have numerous alternatives that can accomplish the objective of creating widespread fear with less difficulty, such as bomb attacks on crowded areas, hijackings, and kidnappings.

Nuclear terrorism has never been practiced. However, Osama bin Laden's Al Qaeda is known to have tried (with no success) to obtain nuclear material and technology (Albright, 2002). Bin Laden's exhortation to Muslims in "The Nuclear Bomb of Islam" to do their "duty" and "prepare as much force as possible to terrorize the enemies of God" has to be taken very seriously (Puzzanghera, 2001).

India has a long history of terrorist activity (Marwah, 2002). A recent report states that as many as 32 groups around the country have been officially banned under the Prevention of Terrorism Act ("TNLA, TNRT, ABNES Banned Under POTA," 2002). The genesis of most current terrorist movements has been internal, with motivations ranging from Marxism to ethnicity. The rise of Pakistan- and Afghanistan-based "jihadi" groups espousing militant Islam is a more recent phenomenon. While the domestically based movements have been relatively local in their focus and have shown no inclination toward mass killing, the jihadi groups are of a different character.

Islamic extremists have steadily increased their presence in Kashmir. The number of foreign militants killed by Indian security forces grew from 30 in 1991 to 194 in 1996, and 541 in 2001 (Sahni, 2002: 215). These groups are driven by a Pan-Islamist agenda that seeks to transform the world order through a "war of a thousand cuts" (Sahni, 2002: 185-196). Not all Muslim terrorist groups active in India are connected to this larger enterprise, but some may be driven toward it by the terror and violence unleashed by extremists of the Hindu majority. For instance, the serial bomb blasts that killed some 250 people in Mumbai in 1993 in what was one of the worst cases worldwide of mass attacks by terrorists before September 11, 2001, were apparently designed to avenge the destruction of a famous mosque by Hindu extremists a year earlier. The anti-Muslim riots in Gujarat state in 2002 have been directly linked to bomb blasts in Mumbai in 2003 (Jha, 2003). The threat of nuclear terrorism from such groups cannot be ruled out if they become further radicalized.

India is located in a wider region of political turbulence and militancy characterized by the ubiquitous presence of terrorism and porous borders. In recent years, radical and terrorist movements have flourished in neighboring Afghanistan, Pakistan, Nepal, Myanmar, Bangladesh, and Sri Lanka. Of these, only two sources of terrorism have

shown the potential to engage in mass killing. The Liberation Tigers of Tamil Eelam (LTTE) in Sri Lanka is one. The LTTE has resources, organizing capability and a capacity for suicide attacks, which would facilitate the handling of radioactive materials without much care for self-preservation. However, it seems to have learned from the Rajiv Gandhi assassination that there are political limits to the use of violence. That single act undermined their cause significantly because it deeply alienated the Indian public, including sympathetic Indian Tamils (Subramanian, 2002).

The main source of a nuclear-terrorist threat, therefore, stems from the jihadi groups that have taken up arms in Kashmir, such as the Harkat-ul-Mujahideen (HuM), the Hizb-ul-Mujahideen (HM) the Jaish-e-Mohammed (JeM) and the Lashkar-e-Toiba (LeT). Of these, only HM has some Kashmiri membership. All of them have a commitment to jihad as well as links to Al Qaeda, and all except HM are ideologically and operationally intertwined with Al Qaeda (Gunaratna, 2002: 208-209). The latter has made it very clear that India is a target. In December 1999, a fax message to the Voice of America in Washington on behalf of Nazeer Ahmed Mujjaid, military adviser to Al Qaeda, proclaimed the goal of these groups: to fight against "Americans, Russians and Indians," and ensure that "Islam will spread over the entire world" (Gunaratna, 2002: 218). Militant leaders have proclaimed Kashmir as a "gateway to India" and established links with fundamentalist and terrorist organizations in different parts of the country, notably in southern India (Sahni, 2002: 212-213).

The politics of the region is conducive to a sustained threat from Al Qaeda and its affiliates. Afghanistan appears to have witnessed the revival of Islamic radicalism. The production of opium has risen dramatically ("Opium Crops Cloud Afghan Recovery," 2003). A third of it is expected to go through India (Sen, 2002). This increases the scope for terrorist activity in the region as there is a close linkage between organized crime, especially the drug trade, and terrorist groups (Raman, 2002).

Pakistan's links to terrorism and Islamic radicalism are well known (Chalk, 2001). Support for terrorists operating in India has been a useful, low-cost instrument to put India under constant pressure. After September 11, 2001, when President Musharraf turned against the radicals, radical Islam has been on the rise, carrying with it a "jihadi culture" of violence hat poses a long-term threat to the region (Cohen, 2003). Al Qaeda is believed by American and Pakistani intelligence services to have set up base in Pakistan (Lumpkin, 2002). Under pressure from India and the US, Musharraf cracked down on terrorism, but by early 2003, most arrested terrorists had been released and the cross-border flow of jihadis into Kashmir was on the rise again (Lancaster & Khan, 2003). The threat environment from the Indian standpoint is aggravated by evidence of the presence of Al Qaeda in Bangladesh. The Harkat-ul-Jihad-al-Islami (HUJI) leader, Abdul Salam Muhammad, also known as Fazlur Rahman, was one of the six constituents of the World Islamic Front for the Jihad against the Jews and the Crusaders announced in 1998 (Gunaratna, 2002: 219).

Given the widespread evidence of Islamic extremists in South Asia, the cause for concern is strong. Immediately after the September 11 attacks, Sheikh Jamilur Rehman, leader of the Tehrik-ul-Mujahideen, explicitly threatened to target Indian nuclear facilities (Pandit,

2001). While this may have been mere rhetoric, there is a real fear arising from Al Qaeda's known interest in acquiring nuclear capability. Qualified personnel are also available in the region. At least two Pakistani nuclear scientists were approached by Osama bin Laden for help in making a bomb (Albright, 2002). While none of this is strong evidence of the advent of nuclear terrorism to South Asia, it does paint a disturbing picture of a potential threat that cannot be ignored. After September 11, 2001, the realm of the possible has been greatly expanded.

3.5. Strategic Sources of Threat

Since India and Pakistan publicly adopted nuclear weapons strategies in 1998, the tension between them has increased, leading to the onset of crises in 1999 and 2001-02 (Koithara, 2003). Pakistan's strategy of subconventional intervention in Indian-held Kashmir, mainly by way of support to terrorist groups, was intensified in the belief that its nuclear deterrent paralyzed India militarily. India, in turn, sought to overcome its perceived paralysis in the face of a rising tide of terrorism by threatening and mobilizing for war. The two predominant features of this spiraling animosity are that the risk of nuclear confrontation, hitherto restrained, has increased; and the capacity of terrorists to generate crises has grown.

The potential for nuclear/radiological terrorism arises from four inter-related sources: the presence of terrorist groups with a proclivity for indiscriminate mass destruction, the high level of tension between and crisis-proneness of India and Pakistan, the steady growth of nuclear arsenals, and the possible change in nuclear posture by both countries. The first factor has already been shown to exist above. So long as groups like Al Qaeda and its affiliates abound in the region, the potential for nuclear/radiological terrorism remains high. India-Pakistan relations, riddled with crises since the 1980s, have become still more unstable since the advent of nuclear weapons. Under the cover of nuclear deterrence, Pakistan has sought to coerce India into negotiation on the disputed state of Jammu & Kashmir by encouraging terrorist groups engaged in "jihad" there (Siddiqa-Agha, 2001: 178-183). This has enhanced the role of terrorists in the region. India, for its part, has attempted to break out of the restraint inherent in the nuclear standoff with Pakistan by threatening to launch an unspecified form of "limited war" against that country (Basrur, 2002). The consequence of the ten-month-long mobilization and confrontation that occurred in 2001-2002 has been prolonged tension and the specter of war, possibly a nuclear one. As a result of these developments, nuclear weapons have been in the forefront of the region's politics. Both India and Pakistan have proclaimed their commitment to "minimum deterrence." This implies the recognition that not many nuclear weapons are required to deter an adversary. But it is not at all clear that there is a lucid understanding of the concept on either side. The fact that they have tested numerous types of warheads and are developing diverse launch vehicles indicates a lack of clarity as to what exactly "minimum" means.

The level of vulnerability to nuclear/radiological terrorism will grow significantly if nuclear weapons inventories expand, and if there is a shift from non-deployment to deployment. All of the risks associated with terrorism are proportionate to the size of an arsenal (though other factors like technical sophistication do matter). The larger a nuclear force, the greater its vulnerability to terrorist assault. This is because more weapons offer

more targets to terrorists; and because an expanding structure has more points of vulnerability to organizational problems of the kind highlighted above. The growth of a nuclear force may be driven by the growth of "operational" concerns as nuclear organizational systems crystallize, by changing perceptions of threat, by bureaucratic interests, or merely by inertia of motion. Above all, it will be hard to resist if the level of tensions, interspersed with crises, remains high. Furthermore, if the trend toward greater diversity – for instance, by the development of a triad – is sustained, numbers will almost certainly go up, since there will be a felt need to ensure that each leg has a "sufficient" number of weapons. The notion that there must be "enough" weapons to make a second strike capability "credible" will inevitably apply to each leg, and the number of weapons – and targets for terrorists – expand accordingly. Whatever the reason, growth in the number of nuclear weapons in an arsenal will increase vulnerability to terrorists.

Deployment is another crucial issue. The continuing hostility between India and Pakistan over Kashmir, punctuated as it has been by frequent crises, portends the possibility of deployment, perhaps at first during a crisis, possibly on a more sustained basis. This increases the scope for a nuclear terrorism-nuclear strategy linkage. Even if the number of weapons remains constant, vulnerability will increase because their distribution will create more opportunities for terrorists. Once a decision to deploy is taken, weapons will be placed in diverse locations, and will be attached to different kinds of missiles, aircraft and, in the more distant future, submarines. Dispersal will create more opportunities for terrorists by offering a range of target choices. It will also create more points at which a security system to protect warheads from attack could fail. The process of transportation will perhaps be the weakest point at which they may be able to strike, since moving assets are likely to be harder to protect. Deployment during a crisis would have the advantage of giving little time for terrorists to target weapons. Against this, when times are not normal, the probability of security failure is higher.

6. Countermeasures

6.1 Logistical countermeasures

Regulatory aspects: The currently applied physical protection practices in India need to be checked objectively with regard to compliance to the *IAEA Convention on Physical Protection of Nuclear Material (CPPNM)* and the *IAEA INFCIRC/225/Rev.4* (IAEA, 1999). Despite their inherent limitations and urgent need for strengthening, these documents provide the only presently existing, internationally acknowledged framework. Such an objective review could be achieved through the services of the *IAEA International Physical Protection Advisory Service (IPPAS)*, which has a proven track record for impartial assessment in a confidential environment involving national security issues.

Security culture: The awareness level for the potential of nuclear and radiological terrorism in India needs to be raised. Internationally operating strategic terrorism will eventually search for the weakest link in *any* nuclear industry world wide, i.e., even if the actual terror attack may not be directed against India, its nuclear infrastructure could be

misused for the diversion of nuclear or other radioactive material, or even a nuclear device. In this regard, the issue of the *insider threat* warrants particular attention, since the majority of cases of fissile material diversion recorded worldwide to date have involved an insider (Zaitseva & Hand, 2003).

Indian Design Basis Threat: The presently applied concept of physical protection needs to be reviewed to ensure that it reflects the significant changes that have resulted from the terror attacks in the US on September 11, 2001 (Steinhausler, Braun & Bunn, 2003). This review process is currently ongoing in many countries and international cooperation is recommended.

Training: Adequate training of customs, border guards, and first responders is essential to regain control, once nuclear or other radioactive material has been diverted. This will require significant investments in terms of updating presently available training courses and the provision of adequate equipment to these groups. As part of this effort, it will be useful to establish also a nation-wide interdepartmental electronic database on incidents involving nuclear and other radioactive materials, ranging from illicit trafficking to criminal misuse of such materials in India.

6.2 Political countermeasures

Strategic Planning: Above all, there is a need for meticulous strategic planning to tackle the nuclear terrorism menace, which has elements of local, national and international security. A task force should be appointed to assume charge of the assessment, planning and execution of a comprehensive strategy. This would include prevention as well as response to a nuclear/radiological terrorist threat. In particular, continuous oversight of the nuclear infrastructure by an independent authority, say a statutory body, is essential to ensure the highest level of security.

Domestic Political Restraint: Notwithstanding the role played by external actors (terrorist groups, states) in terrorism within India's national borders, it is undeniable that domestic groups play a critical role in facilitating the former. At a political level, therefore, it is essential that the links between domestic and external actors be minimized. This involves not only preventive measures such as intelligence, but ensuring that domestic forces which stimulate terrorism are curbed. In this respect, it is incumbent on the state to ensure the prevalence of the rule of law, and to protect minority rights so as to prevent the emergence of disaffected groups that might join hands with, or facilitate the activities of, terrorists bent on wreaking mass destruction.

International Cooperation: Nuclear terrorism is inherently an international problem because the groups that have the potential to perpetrate it span national borders. India has already recognized this by increasing cooperation with agencies like the IAEA and a large number of states, notably the United States and Israel. As a result, it has been able to incorporate best practices and obtain advanced equipment. Further cooperative action through the Proliferation Security Initiative would enhance security by increasing the chances of interdicting the international movement of contraband nuclear/radioactive material. India should also persist with efforts to stabilize its relationship with Pakistan.

After all, both countries have a common interest in preventing acts of nuclear/radiological terrorism.

Nuclear Restraint: Regardless of Pakistan's response to the above, India needs to exercise nuclear restraint by means of a clear understanding of the fundamentals of minimum deterrence, which requires neither large arsenals nor the deployment of weapons to ensure "credibility" (Basrur, 2003). A small, undeployed arsenal would maximize strategic stability and keep to a minimum the scope for terrorists to perpetrate an act of nuclear/radiological terrorism that could have devastating consequences.

References

Abrams, Herbert L., 1991, "Human Reliability and Safety in the Handling of Nuclear Weapons," *Science & Global Security*, 2, pp. 1-26.

Albright, David, 2002, "Al Qaeda's Nuclear Program: Through the Window of Seized Documents," *Policy Forum On-line*, Special Forum No. 47, November 6, Nautilus Institute, Berkeley, CA
< http://www.nautilus.org/fora/Special-Policy-Forum/47_Albright.html>.

Basrur, Rajesh, 2002, "Kargil, Terrorism, and India's Strategic Shift," *India Review*, vol.1, no. 4 (October), pp. 39-56.

Basrur, Rajesh, 2003, "Nuclear India at the Crossroads," Arms Control Today, vol. 33, no. 7, (September), pp. 7-11.

Basrur, Rajesh & Rizvi, Hasan-Askari, 2003, *Nuclear Terrorism and South Asia*, Occasional Paper 25, Cooperative Monitoring Center, Sandia National Laboratories, Albuquerque, NM, February.

Bhushan, Ranjit, 2001, "Shock Therapy," *Outlook*, December 24.
<http://www.outlookindia.com/full.asp?fodname=20011224&fname=Cover+Story&sid=1>.

"Blowing Up in Our Faces," 2001 *Hindustan Times*, May 2.

Cameron, Gavin, 1999, *Nuclear Terrorism: A Threat Assessment for the 21st Century* (Basingstoke & London: Macmillan; New York: St. Martin's Press).

"The Canadian Nuclear FAQ – Section D: Safety and Liability, D 1. Why is the CANDU Design One of the Safest in the World?" (n.d.a)
<http://www.nuclearfaq.ca/cnf_sectionD.htm#q> (accessed on February 15, 2003).

"The Canadian Nuclear FAQ – Section D: Safety and Liability, D 11. How Are Nuclear Plants Protected from Terrorist Attacks?" (n.d.b) <http://www.nuclearfaq.ca/cnf_sectionD.htm#q> (accessed on February 15, 2003).

Chalk, Peter, 2001, "Pakistan's Role in the Kashmir Insurgency," *Jane's Intelligence Review*, September 1, reproduced on the RAND web site <http://www.rand.org/hot/op-eds/090101JIR.html> (accessed on February 14, 2003).

Chari, P. R., 1998, "Protection of Fissile Material: The Indian Experience," *ACDIS Occasional Paper*, Program in Arms Control, Disarmament and International Security, University of Illinois at Urbana-Champaign, September, p. 6.

Chengappa, Raj, 2000, *Weapons of Peace* (New Delhi: HarperCollins).

Cirincione, Joseph, Wolfsthal, Jon B. & Rajkumar, Miriam, 2002, *Deadly Arsenals: Tracking Weapons of Mass Destruction* (Washington, DC: Carnegie Endowment for International Peace).

Cohen, Stephen Philip, 2003, "The Jihadist Threat to Pakistan," *Washington Quarterly*, Vol. 26, No. 3 (Summer), pp. 7-25.

"Complacency Making Army Vulnerable," 2003, *Hindustan Times*, August 3.

Database on Nuclear Smuggling, Theft and Orphan Radiation Sources (DSTO), 2003, Institute of Physics and Biophysics, University of Salzburg, Salzburg, Austria.

Dicus, Greta J., 1999, "USA Perspectives - Safety and Security of Radioactive Sources", *IAEA Bulletin*, Vol. 41, No. 3, pp. 22-27.

Falkenrath, Richard A., Newman, Robert D. & Thayer, Bradley A., 1998, *America's Achilles Heel: Nuclear, Biological, and Chemical Terrorism and Covert Attack* (Cambridge, MA & London: MIT Press).

Gargi, M., 2003, "Uranium Heist," Institute for Peace and Conflict Studies, no. 1077, July 9 <http://www.ipcs.org/ipcs/whatsNewArticle1.jsp?action=showView&kValue=1086&status=article&mod=b>.

Gopalakrishnan, A., 2002, "Evolution of the Indian Nuclear Power Program," *Annual Reviews Energy & the Environment*, 27, pp. 369-395.

Gunaratna, Rohan, 2002, *Inside Al Qaeda: Global Network of Terror* (New York: Columbia University Press).

Hawksley, Humphrey, 2003, "India's Nuclear Muscle," *BBC News*, January 13, <http://news.bbc.co.uk/1/hi/world/south_asia/2646979.stm>.

Hirsch, Daniel, 1987, "The Truck Bomb and Insider Threats to Nuclear Facilities," Nuclear Control Institute, 1987 <http://www.nci.org/g-h/hirschtb.htm>.

Hirsch, Helmut, 2001, "Vulnerability of VVER-1000 Nuclear Power Plants to Passenger Aircraft Crash," WISE, November 2001 <http://www.antenna.nl/wise/terrorism/112001vver.html>.

IAEA, 1999, International Atomic Energy Agency, *Convention on Physical Protection of Nuclear Material*, 1980 <http://www.iaea.org/worldatom/Documents/Legal/cppn.shtml> and INFCIRC/225/Rev. 4 (corrected), *The Physical Protection of Nuclear Material and Nuclear Facilities*, 1999. <http://www.iaea.org/worldatom/Programmes/Protection/inf225rev4/rev4_content.html>.

Jha, Prem Shanker, "The Genesis of Terror," 2003, *Outlookindia.com*, September 8, <http://www.outlookindia.com/full.asp?sid=11&fodname=20030908&fname=Cover+Story>.

Koithara, Verghese, 2003, "Coercion and Risk-Taking in Nuclear South Asia," Center for International Security and Cooperation, Stanford University, Stanford, CA, March.

Kumar, Arun, Agarwal, S. P., Nandakumar, A. N., Kannan, R., and Bhatt, B. C., 2002, "Training Programmes in India for Safety and Security of Radioactive Sources," International Conference on Physical Protection, Salzburg, Austria, September 8-13 <http://www.numat.at/list%20of%20papers/arunkumar.pdf>.

Lancaster, John and Khan, Kamran, 2003, "Extremist Groups Renew Activity in Pakistan," *Washington Post*, February 8.

Leventhal, Paul & Alexander, Yonah, 1986, eds., *Nuclear Terrorism: Defining the Threat* (McLean, VA: Pergamon-Brassey's International Defense Publishers).

Leventhal, Paul & Chellaney, Brahma, 1988, *Nuclear Terrorism: Threat, Perception and Response in South Asia*, Nuclear Control Institute, Washington, DC, October 10.

Lumpkin, John J., 2002, "Al-Qaida [sic] Leaders Said in Pakistan," *Washington Post*, November 11.

Marwah, Ved, 2002, "India," in Yonah Alexander, ed., *Combating Terrorism* (Ann Arbor: University of Michigan Press).

"Massachusetts Congressman Says Nuclear Plants Are Vulnerable," 2002, *New York Times*, March 25.

Murty, Vijay & Layak, Suman, 2003, Radioactive Material Stolen from Jamshedpur Tisco Plant," *Hindustan Times*, August 17.

"No Chance of N-Material Falling into Wrong Hands, " 2002, *Hindu*, July 21.

Nuclear Energy Institute, 2002, *Evaluation of Aircraft Impact on Nuclear Power Plant Structures,* Report NEI-02-04.

"Nuclear Terrorism," n.d., *Three Mile Island Alert* <http://www.tmia.com/sabter.html> (accessed on February 15, 2003).

"Opium Crops Cloud Afghan Recovery," 2003, *BBC News*, September 22 < http://news.bbc.co.uk/go/pr/fr/-/2/hi/business/3127864.stm>.

Pandit, Sharvani, 2001, "Terrorists Vow to Hit Indian N-Sites," *Rediff.com*, September 12 <http://www.rediff.com/news/2001/sep/12ter.htm>.

Potter, William, 1997, "Less Well-Known Cases of Nuclear Terrorism and Nuclear Diversion in the Former Soviet Union," Nuclear Threat Initiative, August. <http://www.nti.org/db/nisprofs/over/nuccases.htm>.

"Probe Ordered into Disarming of Cops by Militants," 2003, *Times of India*, February 15.

Project on Government Oversight, 2001, *U. S. Nuclear Weapons Complex: Security at Risk*, Washington, DC, October.

Puzzanghera, Jim, 2001, "Possibility for Nuclear Terror Too Real to Be Ignored," *Mercury News Washington Bureau*, October 14, reproduced in *ci-ce-ct.com* (web site) < http://www.ci-ce-ct.com/article/showquestion.asp?faq=14&fldAuto=1219> (accessed on February 15, 2003) .

Raman, B., 2002, "Control of Transnational Crime and War against Terrorism: An Indian Perspective," *Outlookindia.com*, May 6 <http://www.outlookindia.com/specialfeaturerem.asp?fodname=20020506&fname=raman&sid=1>.

Sahni, Ajai, 2002, "Extremist Islamist Terror & Subversion," in K. P. S. Gill and Ajai Sahni, eds., *The Global Threat of Terror: Ideological, Material and Political Linkages* (New Delhi: Bulwark Books).

Sandia National Laboratories, 1984, *Investigation of Truck Bomb Threats at Nuclear Facilities,* unpublished report, Albuquerque, NM.

Schweitzer, Glenn E. & Schweitzer, Carole Dorsch, 2002, *A Faceless Enemy: The Origins of Modern Terrorism* (Cambridge, MA: Perseus Publishing).

Sen, Sudhi Ranjan, 2002, "Lion's Share of Afghan Opium Headed for India," *Hindustan Times*, December 1.

Siddiqa-Agha, Ayesha, 2001, *Pakistan's Arms Procurement and Military Buildup, 1979-99* (Basingstoke & New York: Palgrave).

Srivastava, D. N., 2000, "Hi-Tech Computerized Security Management," *Nuclear India*, 34, 3-4 (September-October) <http://www.dae.gov.in/ni/nioct00/nioct00.htm>.

Steinhausler, F., Braun, C. and Bunn, G., 2003, "Strengthening Security at Nuclear Power Plants Against Aircraft Attack," *Journal of Physical Security*, Special Issue, June.

Steinhausler, F., and Bunn, G., 2003, "Protecting the Source: Securing Nuclear Material and Strong Radiation Sources," *IAEA Bulletin*, vol. 45, no. 1 (June), pp. 17-20.

Subramanian, Nirupama, 2002, "It's No More Tiger Country," *Hindu*, July 28.

Thapar, Vishal, 2001, "Ammo Fires: Not Quite Accidental," *Hindustan Times*, August 5.

"TNLA, TNRT, ABNES Banned Under POTA," 2002, *Hindustan Times*, July 3.

"Uranium Racket Unearthed," 2002, *Indian Express*, July 23.

Wolfsthal, Jon B. and Tom Z. Collina, "Nuclear Terrorism and Warhead Control in Russia," *Survival*, vol. 44, no. 2 (Summer), pp. 71-83.

Zaitseva, L., & Hand, K., 2003, "Nuclear Smuggling Chains: Suppliers, Intermediaries, and End-Users," *American Behavioral Scientist*, vol. 46, no. 6, (1 February), pp. 822-844